

**STATIC UNINTERRUPTIBLE POWER SUPPLY
GUIDE SPECIFICATION
Model Eaton 9390 20-160 kVA**

PART 1 - GENERAL

1.01 SUMMARY

- A. This specification describes a three-phase continuous duty, on-line, double conversion, solid-state uninterruptible power system, hereafter referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide power conditioning, back-up and distribution for critical electrical loads. The UPS shall consist of, as required by the project, the UPS module, battery cabinet(s), and accessory cabinet(s) for transformers, maintenance bypass, parallel tie, and distribution applications, and other features as described in this specification.

1.02 UPS SYSTEM DESCRIPTION

- A. UPS System Components: The UPS system shall consist of the following main components:
1. UPS module containing a Rectifier, Inverter, Battery Charger, Static Bypass, and associated Control and Monitor Panel.
 2. Battery string(s) in Line-and-Match Battery Cabinets.
 3. Line-and-Match accessory cabinets for transformer, maintenance bypass, parallel tie, and distribution applications.
 4. Non-matching wall mounted or floor standing maintenance bypass cabinets or multi-module parallel tie cabinets.
- B. UPS Module Modes of Operation: The UPS Module shall operate as an on-line, fully automatic system in the following modes:
1. Normal: Utilizing commercial AC power, the critical load shall be continuously supplied by the Inverter. The Inverter shall power the load while regulating both voltage and frequency. The Rectifier shall derive power from the commercial AC source and shall supply DC power to the Inverter. Simultaneously, the Battery Charger shall charge the battery.
 2. Battery: Upon failure of the commercial AC power, the critical load shall continue to be supplied by the Inverter, which shall obtain power from the batteries without any operator intervention. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source.
 3. Recharge: Upon restoration of the AC source, the Charger shall recharge the batteries and simultaneously the Rectifier shall provide power to the Inverter. This shall be an automatic function and shall cause no interruption to the critical load.
 4. Bypass: If the UPS module must be taken out of the Normal mode for overload, load fault, or internal failures, the static bypass switch shall automatically transfer the critical load to the commercial AC power. Return from Bypass mode to Normal mode of operation shall be automatic. No-break transfer to and from Bypass mode shall be capable of being initiated manually from the front panel.
 5. Energy Saver: The UPS shall continuously monitor the voltage and frequency of the bypass source. When the source parameters are within acceptable limits, the

UPS will utilize a minimal/optimal combination of its internal subsystems to ensure acceptable power is always delivered to the critical load, at a system efficiency of 99% or greater, over the range of 10% to 100% load. The Energy Saver System shall be enabled by the user, and shall be adjustable. It shall incorporate a "High Alert Mode" to automatically (without user intervention) provide maximum power conditioning any time bypass source variation levels exceed preset, adjustable limits. When Energy Saver System is utilized, the UPS must attenuate ANSI C62.41-type line transients to within IEC and ITIC limits. The Energy Saver System shall be able to distinguish between upstream (utility) faults and downstream (load) faults, and react appropriately to protect and support the critical load, without interruption.

1.03 REFERENCES

- A. UL 1778 (Underwriters Laboratories) – Standard for Uninterruptible Power Supply Equipment. Product safety requirements for the United States.
- B. CSA C22.2 No 107.1(Canadian Standards Association) – Commercial and Industrial Power Supplies. Product safety requirements for Canada.
- C. NEMA PE-1 – (National Electrical Manufacturers Association) – Uninterruptible Power Systems standard.
- D. IEC 62040-1-1 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 1-1: General and safety requirements for UPS used in operator access areas.
- E. IEC 62040-1-2 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 1-2: General and safety requirements for UPS used in restricted access locations.
- F. IEC 62040-3 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements.
- G. IEEE 587 (ANSI C62.41) Category A & B (International Electrical and Electronics Engineers) – Recommended practices on surge voltages in low voltage power circuits.
- H. CISPR 22: FCC Rules and Regulations 47, Part 15, Class A (Federal Communications Commission) – Radio Frequency Devices (prior to Feb 16, 2006).
- I. MIL-HDBK-217E (Military Handbook) – Reliability prediction of electronics equipment

1.04 SUBMITTALS

- A. The UPS shall be supplied with sufficient documentation, including the following manuals:
 - 1. Installation and Operation Manual: One copy of the installation and operation manual shall be furnished. It shall possess sufficient detail and clarity to enable the owner's technicians or representatives to install and operate the UPS equipment and accessories. The manual shall include the following major items:
 - a) UPS description
 - b) UPS site planning and unpacking
 - c) UPS installation
 - d) Optional accessory installation
 - e) UPS theory of operation
 - f) Operating procedures
 - g) System events
 - h) UPS maintenance

- i) Performance and technical specifications
- j) Wiring requirements and recommendations
- k) Physical features and requirements
- l) Cabinet dimensions

1.05 QUALIFICATIONS

- A. The UPS manufacturer shall have a minimum of forty years experience in the design, manufacture and testing of solid-state UPS systems. A list of installed UPS systems of the same type as the manufacturer proposes to furnish for this application shall be supplied upon request.
- B. The UPS manufacturer shall have ISO 9001 certification for engineering/R&D, manufacturing facilities and service organization.
- C. The UPS manufacturer shall maintain a staffed 7x24x365 call center for technical and emergency support.
- D. Field Engineering Support: The UPS manufacturer shall directly employ a nationwide field service department staffed by factory-trained field service engineers dedicated to startup, maintenance, and repair of UPS equipment. The organization shall consist of local offices managed from a central location. Field engineers shall be deployed in key population areas to provide on-site emergency response within 24 hours. A map of the United States showing the location of all field service offices must be submitted with the proposal. Third-party maintenance will not be accepted.
- E. Spare Parts Support: Parts supplies shall be located in the field to provide 80% of all emergency needs. The factory shall serve as the central stocking facility where a dedicated supply of all parts shall be available within 24 hours.
- F. Product Enhancement Program: The UPS manufacturer shall make available feature upgrade service offerings to all users as they are developed. These upgrades shall be available as optional field-installable kits.
- G. Maintenance Contracts: A complete range of preventative and corrective maintenance contracts shall be provided and offered with the proposal. Under these contracts, the manufacturer shall maintain the user's equipment to the latest factory revisions.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. The UPS shall withstand any combination of the following external environmental conditions without operational degradation.
 - 1. Operating Temperature: 0 degrees C to + 40 degrees C (32 degrees F to 104 degrees F) without de-rating (excluding batteries).
 - 2. Storage Temperature: - 25 degrees C to + 60 degrees C (-13 degrees F to 140 degrees F). Prolonged storage above + 40 degrees C (104 degrees F) will cause rapid battery self-discharge.
 - 3. Relative Humidity (operating and storage): 95% maximum non-condensing.
 - 4. Elevation:
 - (1) Operational: 6600 ft (2000 m) maximum without de-rating.
 - (2) Transportation: Capable of air transport.

1.07 SAFETY

- A. The UPS shall be certified by Underwriters Laboratories in accordance with UL 1778.
- B. The UPS shall be certified by the Canadian Standards Association in accordance with CSA C22.2 NO.107.1-M91.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers: Eaton Corporation

2.02 UPS MODULE STANDARD FEATURES

The UPS module shall consist of the following standard components:

- A. **Rectifier/Charger:** The rectifier/charger shall convert incoming AC power to regulated DC output for supplying the inverter and for charging the battery. The rectifier/charger shall be a high-frequency PWM design, using Insulated Gate Bi-polar Transistors (IGBTs). The modular design of the UPS shall permit safe and fast removal and replacement of the rectifier/charger module. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode. The rectifier/charger module shall also provide the following:
 - 1. The rectifier shall be capable of drawing power from the utility with a power factor of 0.99 under nominal conditions.
 - 2. The rectifier shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.
 - 3. An option shall be provided to allow the rectifier to be capable of operating from a delta transformer output or high impedance grounded transformer (480V systems only).
- B. **Inverter:** The inverter shall feature an IGBT pulse-width-modulation (PWM) design with high speed switching. The inverter shall also have the following features:
 - 1. The inverter shall be capable of providing the specified quality output power while operating from any DC source voltage (rectifier or battery) within the specified DC operating range.
 - 2. The modular design of the UPS shall permit safe and fast removal and replacement of the inverter module. Mean time to repair (MTTR) for the module shall be no more than 30 minutes in order to return UPS to normal mode.
 - 3. The inverter shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.
- C. **Static Bypass:** The bypass shall serve as an alternative source of power for the critical load when an abnormal condition prevents operation in normal mode. The bypass shall consist of a fully rated, continuous duty, naturally commutated static switch for high-speed transfers. The bypass shall feature the following transfer and operational characteristics.
 - 1. Transfers to bypass shall be automatically initiated for the following conditions:
 - a) Output overload period expired.

- b) Critical bus voltage out of limits.
 - c) Internal over temperature period expired.
 - d) Total battery discharge.
 - e) UPS failure.
 2. Uninterrupted automatic re-transfer shall take place whenever the inverter is capable of assuming the critical load.
 3. Uninterrupted automatic re-transfers shall be inhibited for the following conditions:
 - a) When transfer to bypass is activated manually or remotely.
 - b) In the event of multiple transfers/re-transfer operations the control circuitry shall limit "cycling" to three (3) operations in any ten-minute period. The fourth transfer shall lock the critical load on the bypass source.
 - c) UPS failure.
 4. Uninterrupted manual transfers shall be initiated from the control panel. Uninterrupted manual transfers to bypass and from bypass shall be possible with the inverter logic. During manual transfers to bypass mode, the inverter must verify proper bypass operations before transferring the critical load to the bypass.
 5. All transfers to bypass shall be inhibited for the following conditions:
 - a) Bypass voltage out of limits (+/- 10% of nominal)
 - b) Bypass frequency out of limits (+/- 3 Hz, adjustable, factory set)
 - c) Bypass out of synchronization
 - d) Bypass phase rotation / installation error
 6. Static transfer time: No break, complete in less than 4ms.
 7. The bypass shall be manually energized using the control panel or remotely through a building alarm input.
- D. Monitoring and control components: The following components shall provide monitor and control capability:
 1. Control panel with status indicators.
 2. Alarm and metering display.
 3. Building alarm monitoring.
 4. Communication ports.
- E. Battery management system: The UPS shall contain a battery management system which has the following features:
 1. The battery management system shall provide battery time remaining while operating in normal mode and battery mode. Battery time available information shall be displayed real-time, even under changing load conditions. Upon commissioning, battery runtime information shall be available.
 2. The battery management system shall automatically test the battery string(s) to ensure that the battery is capable of providing greater than 80% of its rated capacity. Testing the batteries shall not jeopardize the operation of the critical load. Upon detection of the battery string(s) not capable of providing 80%, the

UPS system will alarm that the battery needs attention/replacement. The battery test shall be able to detect the following:

- Open battery string
- Shorted battery string
- Battery capacity (runtime) less than 80% of "new" battery capacity

3. The UPS shall communicate battery test and monitoring data to the UPS manufacturer's remote monitoring site. Battery life remaining, capacity, and number of on-battery events shall be provided in a monthly report.
4. An optional temperature sensor shall be available to monitor the ambient temperature internal to the battery cabinet. If the ambient temperature increases, the UPS system charger shall automatically reduce the charging voltage to a level recommended by the battery manufacturer. If the ambient temperature is decreased the UPS shall automatically increase the battery charge voltage to that recommended by the battery manufacturer.

F. Wiring Terminals: For 208Vac 4-wire output configurations, the neutral output compression terminal shall be sized for 200% of UPS module rated current to accommodate higher neutral currents associated with non-linear loads. The UPS module shall contain mechanical compression terminals (adequately sized to accommodate 90°C wiring) for securing user wiring to the following locations:

1. Rectifier/charger input connections (3-wire plus ground)
2. Bypass input connections (3-wire plus ground for 3-wire plus ground output configuration (480Vac), or 4-wire plus ground for 4-wire plus ground output configuration)
3. DC link connections for battery cabinets (positive and negative).
4. AC output connections (3 or 4 wires plus ground).

2.03 UPS MODULE OPTIONS AND ACCESSORIES

The UPS system shall consist of the following options and accessories as required:

- A. Integrated Maintenance Bypass, Distribution, Tie, and Accessory Cabinet(s): Integrated Line-and-Match cabinet(s) shall be provided that include(s):
 1. All hardware and interconnecting cable for connection to UPS module.
 2. Manual maintenance bypass switch to isolate UPS module from commercial AC input and critical load. Switch shall provide complete isolation of UPS for servicing and, if necessary, complete removal and replacement of UPS while still providing bypass power to critical load. Switch shall be make-before-break, interlocked between UPS and bypass to prohibit improper operation.
 3. K-1, K-13 or K20 rated output isolation transformer.
 4. Qty two (2), 42 pole distribution panels with main disconnects for a total of 84 poles of distribution. Up to three (3) distribution circuit breakers may be substituted in lieu of each distribution panel.
 5. Two (2)-module parallel redundant tie cabinet in a Line-and-Match configuration.
- B. SNMP Network Adapter and UPS Power Monitoring Software: SNMP adapters shall provide a communications interface between the UPS module and SNMP-compatible

network management systems. This capability shall allow the unit to be monitored remotely over an Ethernet network using a standard web browser.

1. UPS Power Monitoring Software: This system shall continuously monitor critical power elements associated with the UPS, using the communications port on each module and a customer furnished PC. The system shall automatically alarm if any problems arise and notify local or remote personnel of the alarm condition via email, page, or text message.

C. Battery Cabinet: The battery cabinet shall feature valve regulated, high-rate discharge, lead-acid batteries which provide energy to the support the critical load during a momentary loss of input power to the rectifier. The batteries shall be flame retardant in accordance with UL 94V2 requirements. The battery cabinet shall have the following features:

1. The battery cabinet shall be the same depth and height as the UPS module.
2. The battery cabinet shall feature a mechanical enclosure of like appearance to the UPS module and shall feature casters. Each battery cabinet shall require front access only for installation, service and maintenance. The battery cabinet shall provide top and bottom cable entry.
3. Power wiring internal to each battery cabinet shall be factory provided. Each battery cabinet shall feature up to 10 battery trays which can be individually disconnected from the battery cabinet power wiring with quick disconnect devices. Each battery tray shall be firmly secured to the battery cabinet frame with fasteners. Each battery tray shall be removable from the front of the battery cabinet.
4. Each battery cabinet shall feature a DC rated circuit breaker. The circuit breaker within the battery cabinet shall only provide protection to the battery string within that battery cabinet. For battery configurations involving multiple battery cabinets, a battery string in one battery cabinet may be isolated from the DC link via its circuit breaker without removing other battery strings from the DC link and the UPS module.
5. The circuit breaker in each battery cabinet shall feature an A/B auxiliary switch. The UPS module shall be capable of monitoring and alarming an open battery cabinet circuit breaker condition.
6. The circuit breaker in each battery cabinet shall feature a 48VDC under voltage release device. The UV device shall operate to trip the battery breaker(s) for an emergency power off command or battery disable command.
7. Power and Control wiring between the battery cabinet and the UPS shall be factory provided with compression type connectors between cabinets.
8. The batteries shall be configured with a ¼" spade type connector for attaching sense leads to each jar to facilitate the future addition of a battery monitoring system.
9. Expected battery life: 200 complete full load discharge cycles when operated and maintained within specifications.

D. Module Tie Cabinet. An external cabinet shall be available which shall allow connection of up to four (4) UPS modules to be connected for parallel operation. Module Tie Cabinet rating shall be in accordance with UPS module output ratings. This cabinet shall be utilized where individual UPS module output disconnect and isolation is desired, or when future expansion of a parallel system is planned. Cabinet shall also have the ability to house a(n) (optional) main output breaker and a(n) (optional) bypass breaker. Cabinet

shall be designed for remote installation using customer-supplied wiring and conduit, and shall be capable of free-standing or wall-mounted installation.

2.05 UNINTERRUPTIBLE POWER SUPPLY RATINGS AND OPERATING CHARACTERISTICS

A. UPS Continuous Ratings. The UPS shall be rated:

UPS Rating (max)	Optional Rating (1)	Optional Rating (2)	Optional Rating (3)
40kVA/36kW	30kVA/27kW	20kVA/18kW	n/a
80kVA/72kW	60kVA/54kW	50kVA/45kW	40kVA/36kW
120kVA/108kW	100kVA/90kW	n/a	n/a
160kVA/144kW	120kVA/108kW	100kVA/90kW	n/a

UPS Rating (max) is the maximum output possible from the UPS (for a load power factor range of 0.9 lagging to 0.9 leading). The UPS shall not require derating when supporting a leading power factor load of 0.9 or greater. The UPS may be ordered with any of the three (3) optional ratings (where available) and later upgraded to its corresponding full UPS Rating (max).

B. Rectifier/charger input:

1. Nominal three phase input voltage: 208 (or 480) VAC:
3-wire plus ground for 3-wire plus ground output configuration
2. Operating input voltage range: +10%, -15% of average nominal input voltage without battery discharge.
3. For 60Hz systems, operating input frequency range shall be 55 to 65Hz.
4. Input power factor 0.99 lagging.
5. Normal input current limit: The UPS shall have the following programmable input current limit settings while operating in normal mode:
 - a) Rectifier/charger input current limit shall be adjustable from 100 to 115% of full-load input current.
 - b) Battery input current limit shall be adjustable from 10% to 15% of the UPS full load input current regardless of the actual load on the UPS.
6. On generator input current limit: The UPS shall have the following programmable input current limit settings while operating in normal mode on generator:
 - a) Rectifier/charger input current limit shall be adjustable from 100% to 115% of full-load input current.
 - b) Battery recharge input current limit shall be adjustable from 10% to 15% of the UPS full load input current regardless of the actual load on the UPS.
7. Input current total harmonic distortion (THD) shall be less than 4.5%.
8. Power walk-in: Ramp-up to full utility load adjustable from 3 seconds to 60 seconds.

C. Bypass input:

1. Synchronizing bypass voltage range shall be +/- 10% of average nominal input voltage.
2. Synchronizing bypass frequency range is centered on the nominal frequency.
3. Bypass and rectifier inputs can be supplied from out of phase sources if required.
4. Input surge withstand capability: The UPS shall be in compliance with IEEE 587 (ANSI C62.41), category A & B (6kV).

D. Rectifier/charger output:

1. Nominal DC voltage shall be variable between 384VDC to 480VDC for 208V input, and between 432VDC to 480VDC for 480V input.
2. Steady state voltage regulation shall be +/- 0.5%.
3. Voltage ripple shall be less than 0.5% (peak-to-peak).
4. Capacity: The rectifier/charger shall support a fully loaded inverter and recharge the battery to 90% of its full capacity within 10 times the discharge when input current limit is set at maximum.
5. Low line operation: The rectifier/charger shall be capable of sharing the DC load with the battery when the input voltage falls below the specified operation input voltage range, the on battery indicator shall enunciate operation in this mode.
6. DC sensing: Redundant DC voltage sensing methods shall be incorporated for providing battery over-voltage protection.
7. Battery charger characteristics: The UPS battery charging system shall have the following characteristics:
 - a) The charger shall be capable of being configured for several charge modes including:
 - (1) A charging mode that increases battery life by allowing the battery to rest, reducing positive plate corrosion
 - (2) A charging mode floating the battery at a set level, which can be adjusted via software, used for flooded cell applications
 - (a) Nominal Float Voltage: 2.25 V per cell.
 - (b) Equalizing Voltage: 2.38 V maximum per cell (adjustable).
 - (c) Automatic (time based) or manual (user initiated) equalization available
 - b) UPS module will automatically adjust battery shutdown based upon loading and battery capacity.
 - (1) The UPS module shall automatically adjust the final discharge voltage between 1.67 and 1.75 Volts per cell based on the existing load and the rate and length of discharge.
 - (2) The absolute minimum operational voltage is 1.67 V per cell (adjustable).
8. The UPS module will automatically disconnect the battery system in case of full battery discharge followed by prolonged utility AC voltage failure. The time window before battery disconnection occurs shall be programmable for both time and voltage.

E. UPS output in normal mode

1. Nominal output voltage 208 VAC, 3-phase, 3 wire or 4-wire (or 480V, 3-phase, 3-wire or 4-wire) plus ground at the output of the Integrated Distribution and Bypass cabinet. Output wiring configuration is based upon input wiring configuration for systems without internal transformers.
2. Steady-state voltage regulation (in inverter) shall be within +/- 1% average from nominal output voltage.
3. Transient voltage response shall be < +/- 5% from nominal voltage for 100% load step, full load re-transfers and full load drop on battery.
4. Transient voltage recovery shall be 25ms to within +/- 1% of steady state.
5. Linear load harmonic distortion capability: Output voltage THD of less than 2% for 100% linear load.
6. Non-linear load harmonic distortion capability: Output voltage THD of less than 5% for 100% non-linear load when tested using the non-linear load described in IEC 62040-3 connected line to neutral.
7. Manual output voltage adjustment shall be +/- 3% from nominal.
8. Line synchronization range shall be +/- 3Hz, adjustable to +/- 5Hz.
9. Frequency regulation shall be +/- 0.01Hz free running.
10. Frequency slew rate shall be 1 Hz/second maximum (adjustable).
11. Phase angle control:
 - a) Balanced linear load shall be +/- 1 degree from nominal 120 degrees
 - b) Unbalanced linear loads shall less than +/- 5 degrees from average phase voltage for 100% load unbalance.
12. Phase voltage control:
 - a) Balanced linear loads shall be +/- 1% from average phase voltage
 - b) Unbalanced linear loads shall be less than +/- 5% for 100% load unbalanced
13. Overload current capability (with nominal line and fully charged battery): The unit shall maintain voltage regulation for up to 110% of resistive/inductive load for 10 minutes, up to 125% for 30 seconds, and up to 150% for 10 seconds.
14. Fault clearing current capability: 150% phase-to-phase for 10 cycles; 300% phase-to-neutral for up to 10 cycles
15. Static transfer time: No break, completed in less than 4ms.
16. Common mode noise attenuation:
 - a) -65dB up to 20kHz, -40db up to 100kHz
 - b) > 100dB with isolation transformer
17. Acoustical noise: Noise generated by the UPS under normal operation shall not exceed 65dbA at one meter from any operator surface, measured at 25 degrees C (77 degrees F) and full load.
18. EMI Suppression: The UPS shall meet FCC rules and regulation 47, part 15, for Class A devices prior to Feb 16, 2006, CISPR .
19. Electrostatic discharge (ESD): The UPS shall meet IEC 801-2 specifications. The UPS shall withstand a 25 kV pulse without damage and with no disturbance or adverse effect to the critical load.
20. Efficiency: The UPS efficiency shall be up to 94%.

F. UPS Output with Energy Saver System option

1. The Energy Saver System acts to optimize the internal components of the UPS power train to maximize system efficiency when the bypass source is within the following (adjustable) limits: Voltage: +/-10%, and Frequency: +/-3Hz.
2. Nominal output voltage 208 VAC, 3-phase, 3 wire or 4-wire (or 480V, 3-phase, 3-wire or 4-wire) plus ground at the output of the Integrated Distribution and Bypass cabinet. Output wiring configuration is based upon input wiring configuration for systems without internal transformers.
3. Steady-state voltage regulation shall be within +/- 10% from nominal output voltage.
4. Line synchronization range shall be +/- 3Hz, adjustable to +/- 5Hz.
5. Frequency regulation shall be +/-3Hz when bypass source is within the limits in (1) above, and +/- 0.01Hz free running,
6. Overload current capability (with bypass source within the limits of (1) above) 1000% for 20msec, 600% for 50 ms
7. Static transfer time: No break, completed in less than 2ms, including detection time.
8. Acoustical noise: Noise generated by the UPS under normal operation shall not exceed 65dbA at one meter from any operator surface, measured at 25 degrees C (77 degrees F) and full load.
9. EMI Suppression: The UPS shall meet FCC rules and regulation 47, part 15, for Class A devices prior to Feb 16, 2006.
10. Electrostatic discharge (ESD): The UPS shall meet IEC 801-2 specifications. The UPS shall withstand a 25 kV pulse without damage and with no disturbance or adverse effect to the critical load.
11. Efficiency: The UPS efficiency shall greater than 99%, over the range of 10 to 100% load. (98.5% for 208V units)

G. UPS in Parallel Configurations:

UPS modules shall be capable of being paralleled to increase system power levels or to provide redundant power. A total of eight (8) UPS modules shall be capable of parallel operation, either for capacity or redundant systems. It shall be possible to parallel up to six (6) UPS modules without a central bypass cabinet. The parallel system shall have intelligence to automatically recognize the need for capacity and/or redundancy. Parallel systems shall utilize autonomous UPS power modules that do not rely on any control interconnections for synchronized operation. The individual modules shall operate in a peer-to-peer manner to provide automatic load sharing, synchronization, and selective tripping capabilities. "Master-slave" configurations are not acceptable.

The parallel system shall utilize a communications network to provide system information and status, such as operating mode and meter data. This network shall provide individual module information as well as total system information, and individual module information shall be available from any module's front panel display. The loss of this system information network shall not cause the parallel units to transfer to bypass or drop the critical load.

2.06 MECHANICAL DESIGN

- A. Enclosures: The UPS shall be housed in free-standing double front enclosures (safety shields behind doors) equipped with casters and leveling feet. The enclosures shall be

designed for computer room applications. Front doors shall have locks to prevent unauthorized entry.

- B. Ventilation: The UPS shall be designed for forced-air cooling. Air inlets shall be on the front of the unit. Air outlets shall be on the top. Eighteen inches of clearance over the UPS outlets shall be required for proper air circulation. Air filters shall be commonly available sizes.
- C. No back or side clearance or access shall be required for the system. The back and side enclosure covers shall be capable of being located directly adjacent to a wall.
- D. Cable entry: Standard cable entry for the UPS cabinet shall be through either the enclosure bottom or top. A dedicated wireway shall be provided within the UPS cabinet for routing user input and output wiring.
- E. Front access: All serviceable subassemblies shall be modular and capable of being replaced from the front of the UPS (front access only required). Side or rear access for installation, service, repair or maintenance of the UPS system shall not be required.
- F. Service area requirements: The 208Vac system shall require no more than thirty-six (36) inches of front service access room and shall not require side or rear access for service or installation. The 480Vac system shall require no more than forty-two (42) inches of front service access room and shall not require side or rear access for service or installation.

2.07 CONTROLS AND INDICATORS

- A. Microprocessor controlled circuitry: The UPS controls shall have the following design and operating characteristics:
 - 1. Fully automatic operation of the UPS shall be provided through the use of microprocessor controlled Digital Signal Processing. DSP shall eliminate variances from component tolerance or drift, and provide consistent operational responses.
 - 2. All operating and protection parameters shall be firmware controlled, thus eliminating a need for manual adjustments. The logic shall include system test capability to facilitate maintenance and troubleshooting. Printed circuit board replacement shall be possible without requiring calibration.
 - 3. Start-up and transfers shall be automatic functions.
- B. Digital Front Panel Display: The UPS control panel shall be a digital front panel display that features an 8x40 (8 lines, each with 40 characters) backlit LCD display. The LCD shall display UPS status, metering, battery status, alarm/event queue, active alarms and UPS configurations. The front panel display shall show a system mimic diagram with an outlined power path, current operating mode and event logs.
- C. Control Panel Indicators: The UPS control panel shall provide the following monitoring functions with indicator LED's:
 - 1. NORMAL: This shall indicate that the commercial AC utility or generator source is supplying power to the rectifier and the inverter is supporting the critical load. A text message shall indicate if the bypass line is not within tolerance.
 - 2. BYPASS: This shall indicate that the UPS has transferred the load to the bypass circuit.
 - 3. BATTERY: This shall indicate that the commercial AC utility or generator source has failed and the battery is supplying power to the inverter, which is supporting

- the load. A text message shall indicate if the battery charge is low or if the battery is installed but disconnected.
4. ALARM: This shall indicate that the UPS detects an alarm condition, outlined in detail in the operator's manual.
- D. Control Panel Controls: The UPS control panel shall provide the following functions from front panel push buttons:
1. EVENTS: Displays the list of Active System Events and a historical log of system events. Historical logs shall include a detailed time stamped list of the latest 128 events.
 2. METERS: Displays performance meters for the system or critical load. When selected, the front display shall show individual screens of input parameters, output parameters or bypass parameters including; voltage, current and frequency. In addition, the battery display shall show runtime remaining.
 3. CONTROLS: Displays a System Controls screen. Allows selection of operating mode, normal, bypass, charger on/off and Power Module on/off.
 4. SETUP: Allows display contrast, date and time information serial communication port configuration and display of firmware revision numbers.
 5. RETURN: Confirms selection or returns to previous screen.
- E. Interface panel: The UPS shall be equipped with an interface panel, located behind a protective cover, which provides the following signals and communication features in a Class 2 environment:
1. Alarm contact: A dry contact for annunciating a summary alarm shall be provided for customer use. This contact shall be Form "C" capable of supplying both N/O and N/C contacts. Contact ratings shall be 5A max at a voltage not to exceed 28VDC or 277VAC.
 2. RS232 (EIA / TIA-232) communications interface: Circuitry shall be provided for one RS232 (EIA / TIA-232) communication port for connection to automated service department diagnostic tools. This port may be used with simple ("dumb") terminals to gain remote access to all unit operation information.
 3. Building alarms: Two inputs shall be provided for monitoring the status of external dry contacts. Building alarms shall be set up through the UPS configuration mode function on the RS232 (EIA / TIA-232) port.
 4. External EPO contacts: Shall be provided to connect an external remote emergency power off switch to shutdown the UPS and de-energize the critical load.
 5. Battery control contacts: Contacts shall be provided to connect the battery UVR and auxiliary signals from a battery breaker or battery disconnect switch.
 6. External bypass indicator connection: A connection point shall be provided to acknowledge that an external maintenance bypass has been closed around the UPS, placing the critical load on utility power.
 7. The system shall have options to add four (4) additional building alarms, 384 logged events, 4 additional languages, Mandarin or Russian as a primary language.

2.08 COMMUNICATIONS

- A. Communications Bay: The UPS shall be equipped with field configurable communications bays that will accommodate four (4) communication devices
- B. Remote Monitoring:
 - 1. Optional WEB/SNMP communication capabilities will be available for all systems.
 - 2. The UPS shall be able to be monitored remotely via communications devices. UPS manufacturer shall provide optional communications devices capable of communicating via various industry standard protocols such as RS232 and ModBus. Monitoring of UPS status may also be performed through isolated dry contact Form C relays.
 - 3. Remote monitoring of the UPS shall also be possible through status indicators elsewhere in the same facility through a device that replicates these indicators.

The UPS communication capability should be able to integrate into any industry standard Building Management System (BMS) and/or Network Management System (NMS). The UPS must also be able to be monitored via any standard Internet browser (i.e. Internet Explorer and Netscape).

All optional hardware interfaces shall be "Hot-swappable" (UPS maintains power to critical applications while changing interfaces).

- C. Shutdown:
 - 1. There shall be a mechanism that provides graceful, orderly, unattended, sequential shutdown of one or multiple computers powered by one UPS. This shutdown shall be performed via in-network or out-of-network means. The order of shutdown shall be user-defined, allowing the maximization of runtime on battery for more critical systems.
 - 2. Shutdown of AS/400 computers shall be possible through open-collector relay contacts or isolated, dry contact, Form-C relays.
 - 3. The UPS shall also be capable of interfacing with an operating system's built-in shutdown routine, e.g. Windows NT. This shall be done through a cable connection to the optional serial port on the UPS.
- D. Notification:
 - 1. There shall be a mechanism to send alerts to key personnel via email or SNMP traps. An alarm notification may also be sent by a network message.
 - 2. Dial-out to a computer for alarm notification may be performed. The user may respond by dialing-in to retrieve alarm history and a summary of current meter status.
 - 3. Management: A remote battery test may be performed via an Ethernet network. The UPS shall be tested through invoking a single command.

2.08 UPS MODULE PROTECTION

- A. Rectifier/Charger and Bypass protection shall be provided through individual fusing of each phase.
- B. Battery protection shall be provided by thermal-magnetic molded-case circuit breakers in each battery cabinet (if standard battery pack is provided) or external protective device for an external battery.
- C. Electronic current limiting circuitry and fuses in the Inverter circuit shall provide output protection.

- D. To comply with agency safety requirements, the UPS module shall not rely upon any disconnect devices outside of the UPS module to isolate the battery cabinet from the UPS module.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.02 COMMISSIONING

- A. Factory start-up shall be provided on a 5x8 basis (7 x 24 optional). Start-up service shall be provided at no extra charge and shall include one visit to perform all procedures and tests specified within UPS Installation and Operation manual. UPS manufacturer shall also offer the following optional services:
 - 1. Pre-energize visit to inspect installation and provide guidance to installers as required.
 - 2. Post-start-up visit for alarm notification configuration, operator training, generator testing, etc.

- B. The following procedures and tests shall be performed by Field Service personnel during the UPS startup:
 - 1. Visual Inspection:
 - a) Visually inspect all equipment for signs of damage or foreign materials.
 - b) Observe the type of ventilation, the cleanliness of the room, the use of proper signs, and any other safety related factors.
 - 2. Mechanical Inspection:
 - a) Check all the power connections for tightness.
 - b) Check all the control wiring terminations and plugs for tightness or proper seating.
 - 3. Electrical Pre-check:
 - a) Check the DC bus for a possible short circuit.
 - b) Check input and Bypass power for proper voltages and phase rotation.
 - c) Check all lamp test functions.
 - 4. Initial UPS Startup:
 - a) Verify that all the alarms are in a "go" condition.
 - b) Energize the UPS module and verify the proper DC, walkup, and AC phase on.
 - c) Check the DC link holding voltage, AC output voltages, and output waveforms.
 - d) Check the final DC link voltage and Inverter AC output. Adjust if required.
 - e) Check for the proper synchronization.

- f) Check for the voltage difference between the Inverter output and the Bypass source.
 - g) Optional on site full-load, step-load, and battery discharge tests using supplier furnished load bank, shall also be offered.
5. Operational Training: Before leaving the site, the field service engineer shall familiarize responsible personnel with the operation of the UPS. The UPS equipment shall be available for demonstration of the modes of operation.

3.03 WARRANTY

All components of the UPS system shall be covered by a standard one-year limited factory warranty and service protection package.

One-year limited factory warranty shall include replacement coverage for the UPS parts for a period of 18 months from shipment or 12 months from start-up, whichever occurs sooner.

One-year service protection package shall include 7x24 on-site repair/replacement labor for UPS parts and batteries; 7x24 technical support coverage; and 7x24 remote monitoring service (with monthly reports for UPS and battery performance). Standard response time shall be 8 hours from receipt of call. Manufacturer shall also offer, as an option, 7x24 on-site service support with guaranteed response times of 4, or 2 hours in certain major metropolitan areas. Additional preventive maintenance visits shall be available as an option for both UPS and battery components.

Manufacturer shall also include Start-up services consisting of: 5x8 Start-up service of UPS and batteries, with option for 7x24 Start-up. On-site user training, Site Audit, installation and commissioning of monitoring service, and validation of one-year limited factory warranty will be performed during the start-up.

Manufacturer shall also offer an optional service plan to provide 7x24 on-site coverage (preventive and corrective) for UPS and batteries, guaranteed response time, remote monitoring, Web access to service site history, annual Site Audit, UPS and battery preventive maintenance visit, and discounts on upgrade and modification kits. Manufacturer shall also provide an optional battery service plan to provide parts-and-labor coverage for partial and full battery strings, either with preventive maintenance or replacement coverage.

END